100

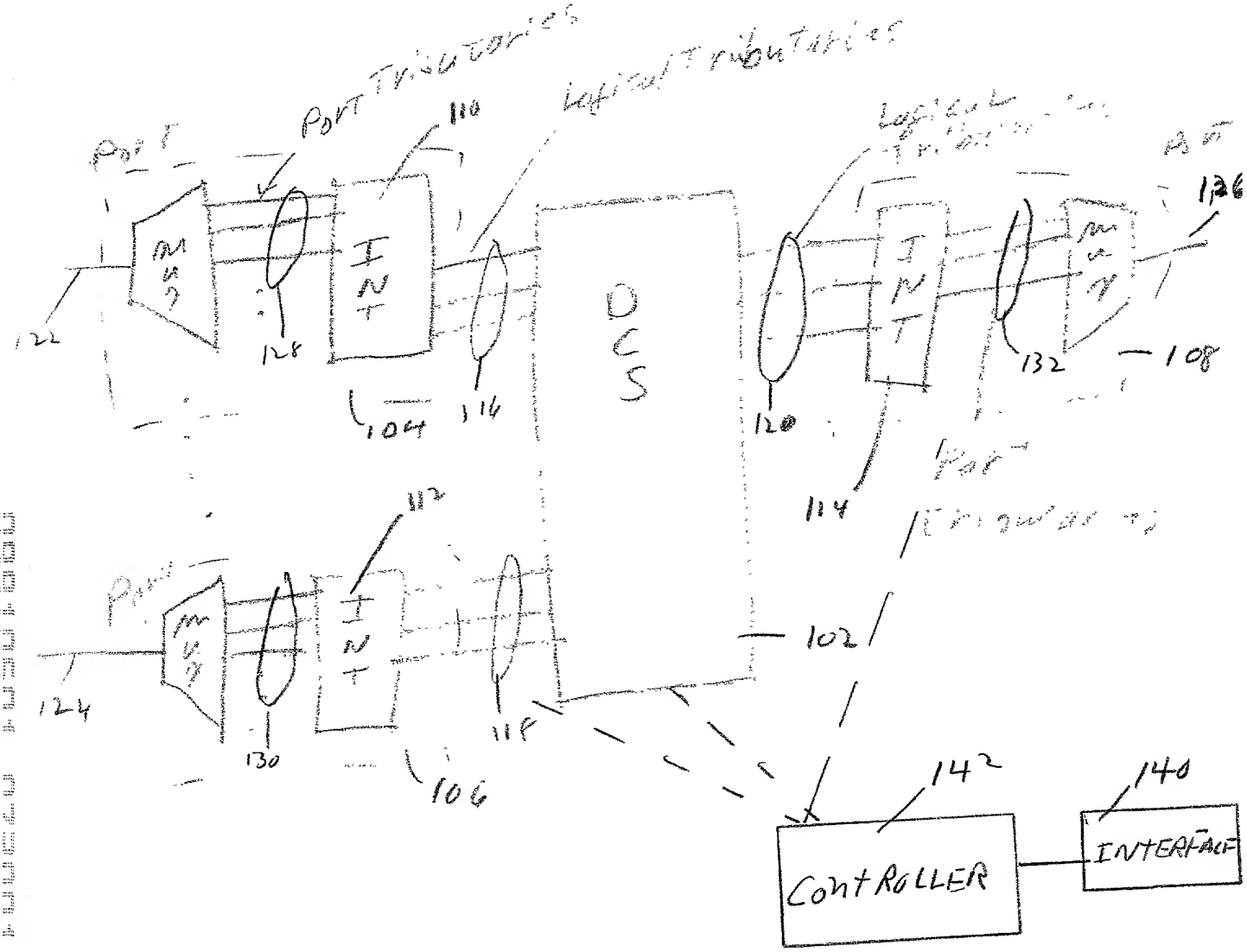
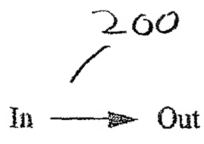

110
122
128
104
116
DCS
120
126
132
108
114
112
124
130
106
102
142
CONTROLLER
140
INTERFACE

FIGURE 1

Atomic Cross-Connection Topologies



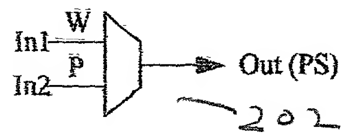
Point-to-Point

consists of:

one leg (In-Out)

reported leg or leg-pair:

1way
2way



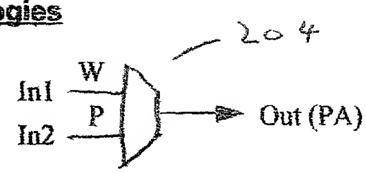
Path-Protected

consists of:

path protection group
working leg (In1-Out)
protection leg (In2-Out)

reported leg or leg-pair:

1wayPS,W
1wayPS,P



Adjunct Path-Protected

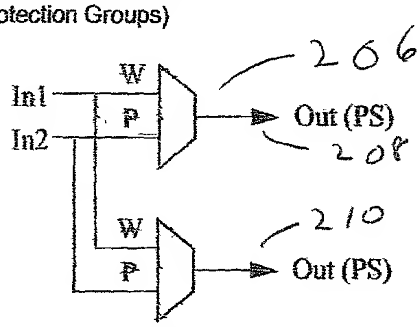
consists of:

adjunct working leg (In1-Out)
adjunct protection leg (In2-Out)

reported leg or leg-pair:

1wayPA,W
1wayPA,P

Example with Bridged Path-Protected Cross-Connections
(Separate Path Protection Groups)



Example with Path-Protected and Adjunct Path-Protected Cross-Connections
(Common Path Protection Group)

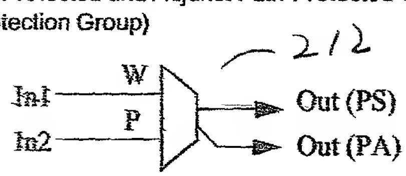


FIGURE 2

FIGURE 3A

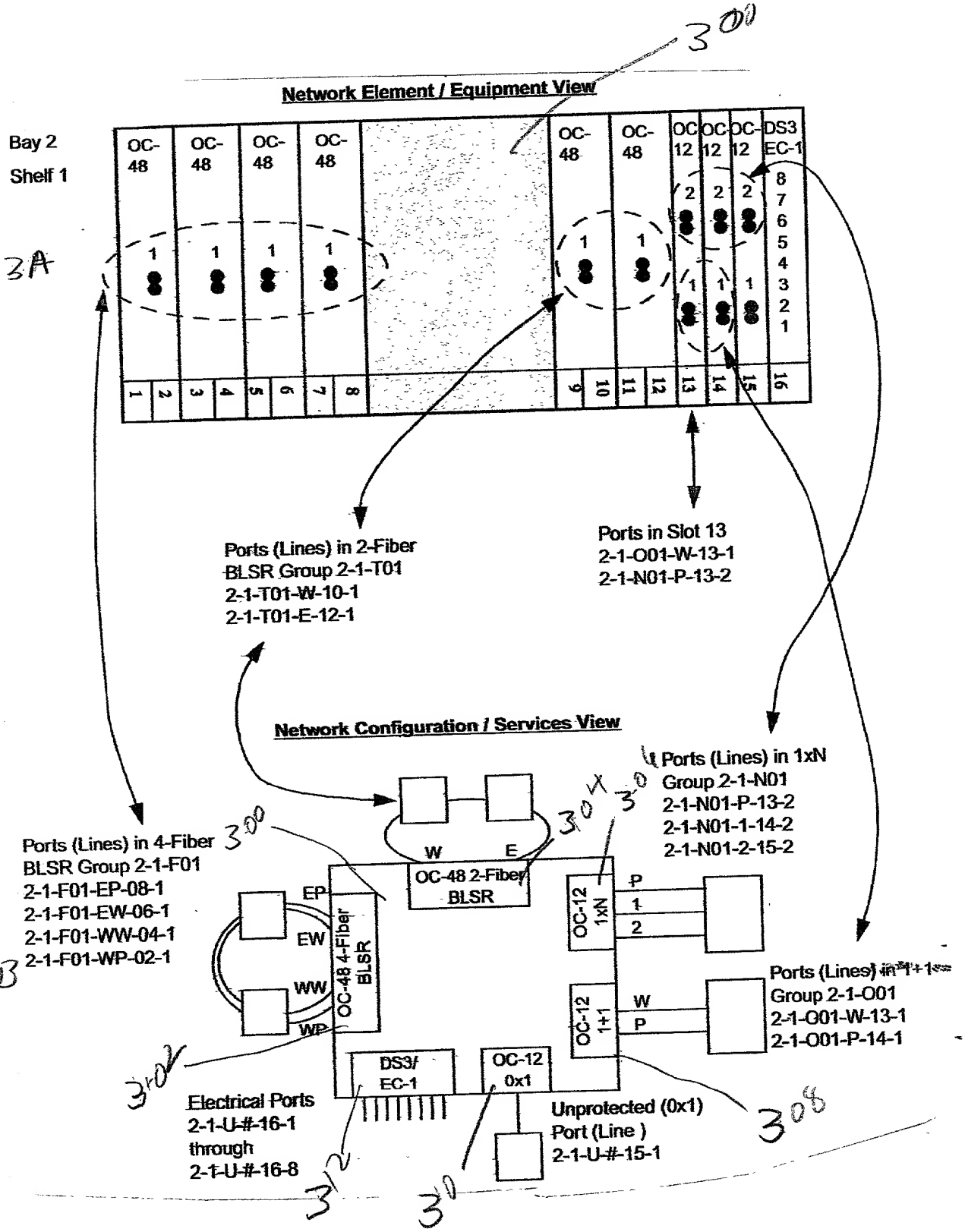


FIGURE 3B

FIGURE 4

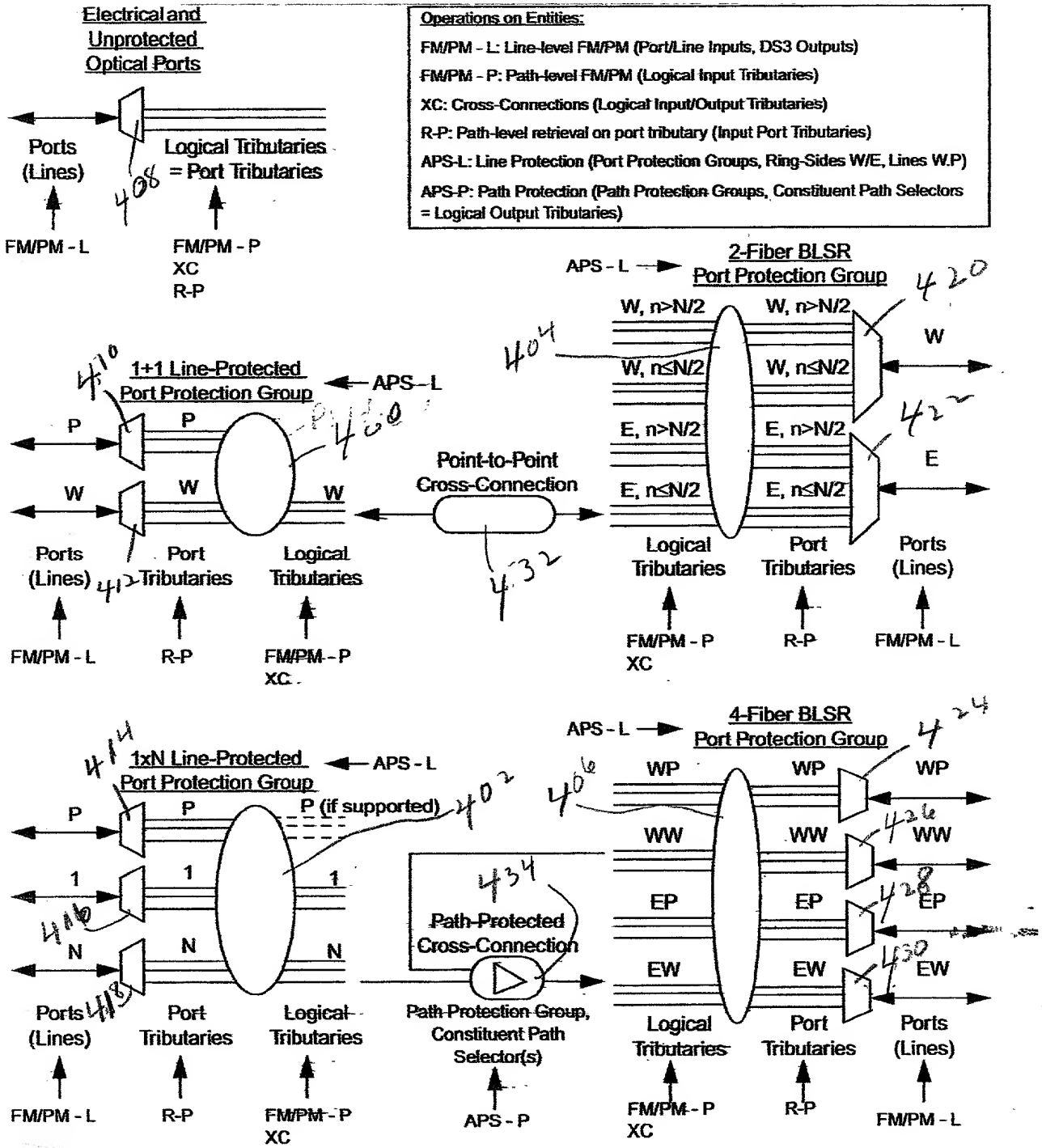
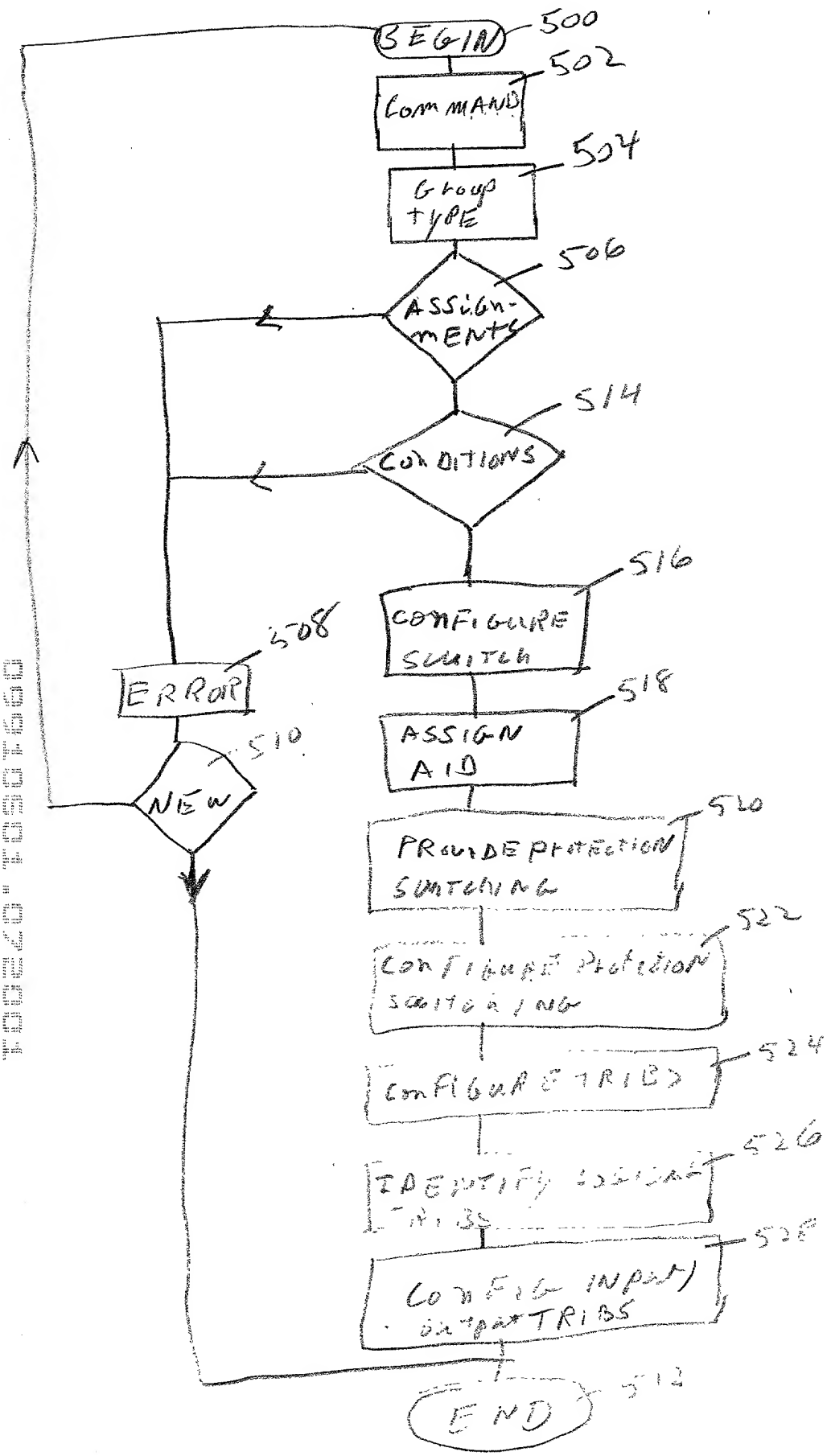

Electrical and Unprotected Optical Ports
Ports (Lines)
Logical Tributaries = Port Tributaries
408
FM/PM - L
FM/PM - P
XC
R-P
Operations on Entities:
FM/PM - L: Line-level FM/PM (Port/Line Inputs, DS3 Outputs)
FM/PM - P: Path-level FM/PM (Logical Input Tributaries)
XC: Cross-Connections (Logical Input/Output Tributaries)
R-P: Path-level retrieval on port tributary (Input Port Tributaries)
APS-L: Line Protection (Port Protection Groups, Ring-Sides W/E, Lines W.P)
APS-P: Path Protection (Path Protection Groups, Constituent Path Selectors = Logical Output Tributaries)
2-Fiber BLSR Port Protection Group
APS - L
420
404
W, n>N/2
W, n≤N/2
E, n>N/2
E, n≤N/2
W
E
1+1 Line-Protected Port Protection Group
APS - L
410
P
W
400
Point-to-Point Cross-Connection
432
412
Ports (Lines)
Port Tributaries
Logical Tributaries
FM/PM - L
R-P
FM/PM - P
XC
Logical Tributaries
Port Tributaries
Ports (Lines)
FM/PM - P
XC
R-P
FM/PM - L
4-Fiber BLSR Port Protection Group
APS - L
424
406
WP
WW
EP
EW
426
428
430
1xN Line-Protected Port Protection Group
APS - L
414
P
1
N
P (if supported)
402
434
Path-Protected Cross-Connection
416
418
Ports (Lines)
Port Tributaries
Logical Tributaries
FM/PM - L
R-P
FM/PM - P
XC
Path Protection Group, Constituent Path Selector(s)
APS - P
Logical Tributaries
Port Tributaries
Ports (Lines)
FM/PM - P
XC
R-P
FM/PM - L

FIGURE 5


BEGIN
500
COMMAND
502
GROUP TYPE
504
ASSIGN-MENTS
506
CONDITIONS
514
CONFIGURE SWITCH
516
ERROR
508
ASSIGN AID
518
NEW
510
PROVIDE PROTECTION SWITCHING
520
CONFIGURE PROTECTION SWITCHING
522
CONFIGURE TRIBS
524
IDENTIFY ASSIGNMENTS
526
CONFIG INPUT/OUTPUT TRIBS
528
END
512

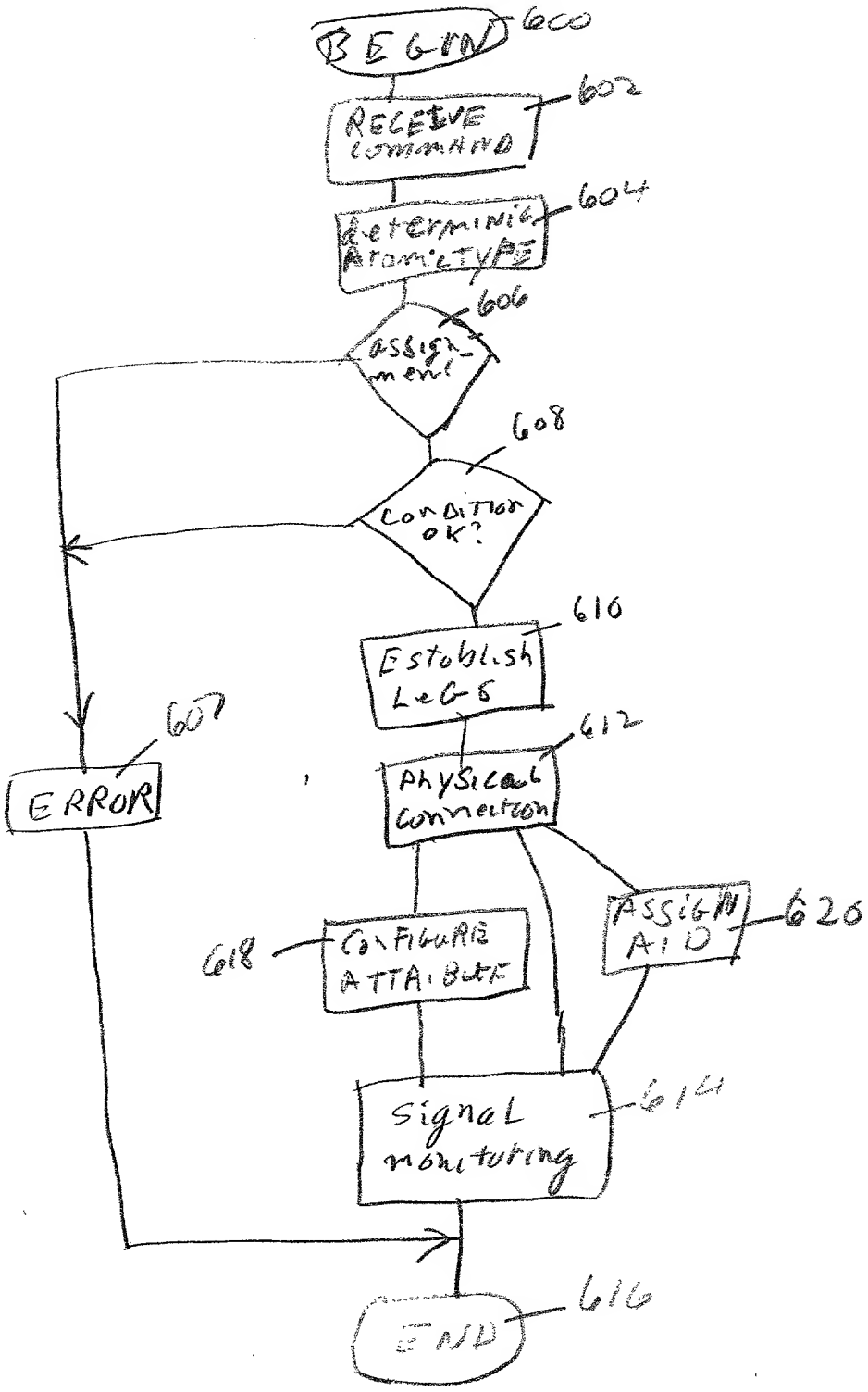

BEGIN
600
RECEIVE COMMAND
602
DETERMINE ATOMIC TYPE
604
ASSIGN-MENT
606
CONDITION OK?
608
ERROR
607
ESTABLISH LEGS
610
PHYSICAL CONNECTION
612
CONFIGURE ATTRIBUTE
618
ASSIGN AID
620
SIGNAL MONITORING
614
END
616

FIGURE 6

FIGURE 7

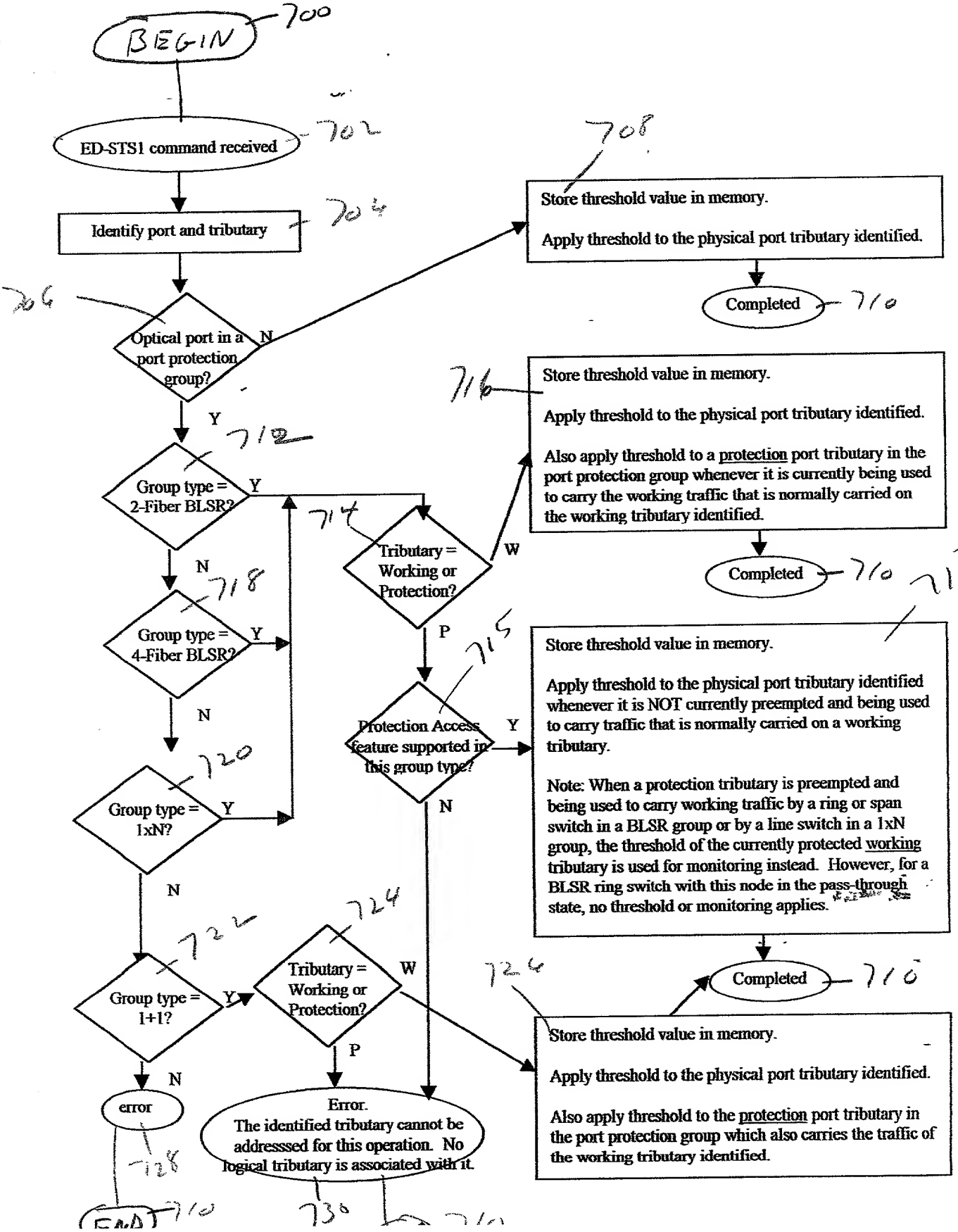

BEGIN
700
ED-STS1 command received
702
Identify port and tributary
704
706
Optical port in a port protection group?
N
Y
708
Store threshold value in memory.
Apply threshold to the physical port tributary identified.
Completed
710
712
Group type = 2-Fiber BLSR?
Y
N
714
Tributary = Working or Protection?
W
P
716
Store threshold value in memory.
Apply threshold to the physical port tributary identified.
Also apply threshold to a protection port tributary in the port protection group whenever it is currently being used to carry the working traffic that is normally carried on the working tributary identified.
Completed
710
718
Group type = 4-Fiber BLSR?
Y
N
715
Protection Access feature supported in this group type?
Y
N
717
Store threshold value in memory.
Apply threshold to the physical port tributary identified whenever it is NOT currently preempted and being used to carry traffic that is normally carried on a working tributary.
Note: When a protection tributary is preempted and being used to carry working traffic by a ring or span switch in a BLSR group or by a line switch in a 1xN group, the threshold of the currently protected working tributary is used for monitoring instead. However, for a BLSR ring switch with this node in the pass-through state, no threshold or monitoring applies.
Completed
710
720
Group type = 1xN?
Y
N
722
Group type = 1+1?
Y
N
724
Tributary = Working or Protection?
W
P
726
Store threshold value in memory.
Apply threshold to the physical port tributary identified.
Also apply threshold to the protection port tributary in the port protection group which also carries the traffic of the working tributary identified.
error
728
END
710
Error.
The identified tributary cannot be addresssed for this operation. No logical tributary is associated with it.
730
710

FIGURE 8

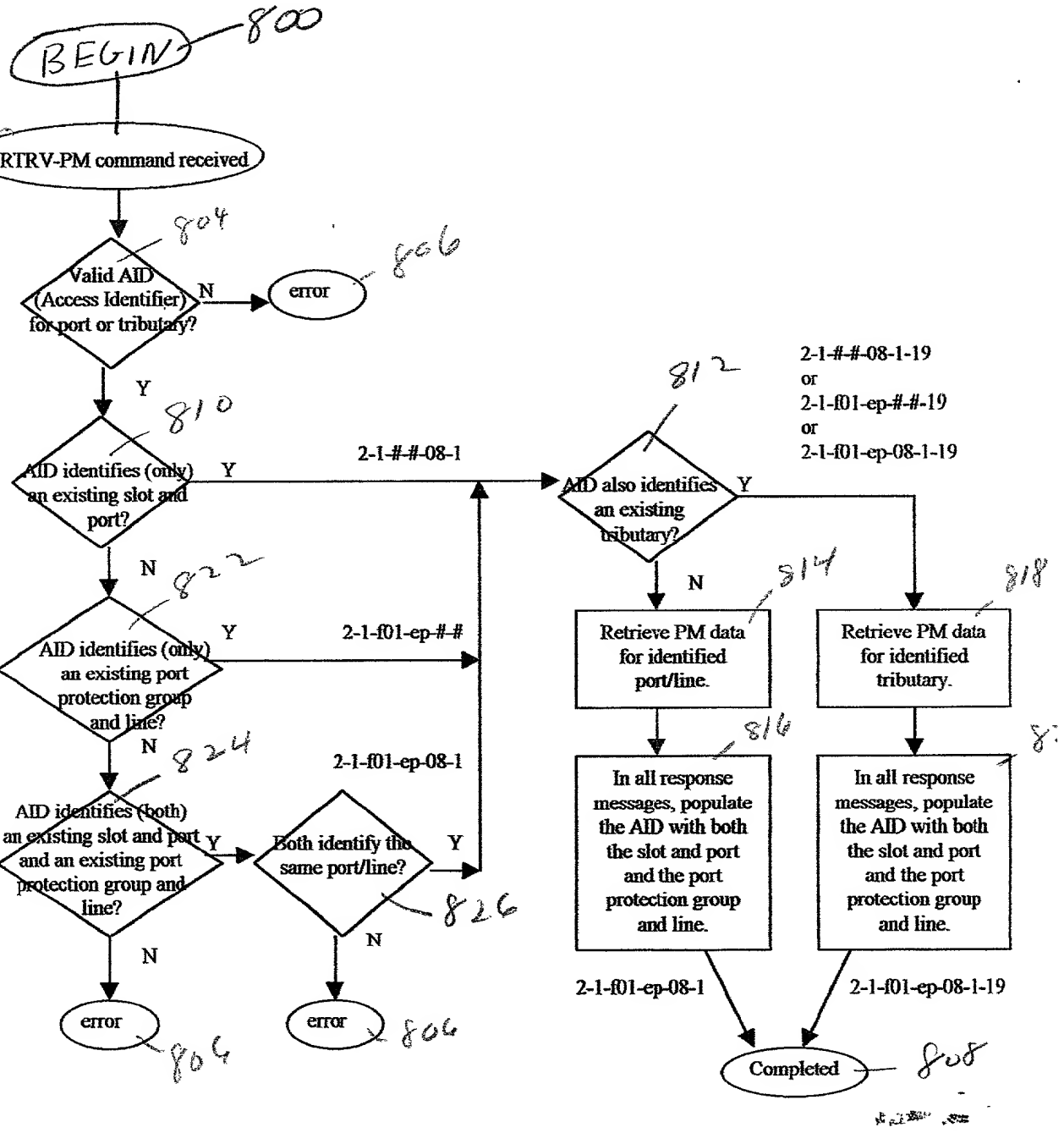
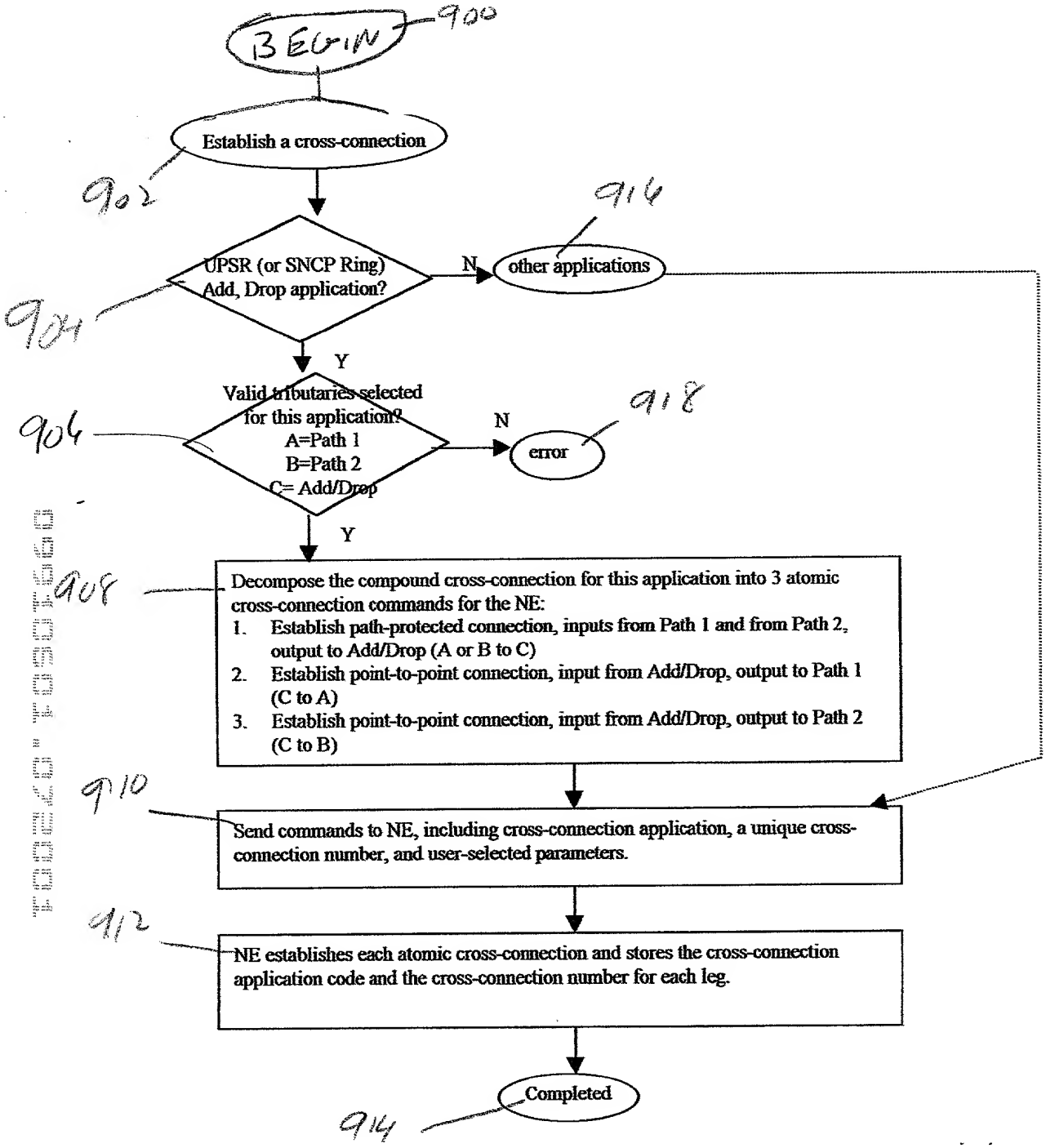

BEGIN
800
RTRV-PM command received
802
Valid AID (Access Identifier) for port or tributary?
804
N
error
806
Y
AID identifies (only) an existing slot and port?
810
Y
2-1-#-#-08-1
N
AID identifies (only) an existing port protection group and line?
822
Y
2-1-f01-ep-#-#
N
AID identifies (both) an existing slot and port and an existing port protection group and line?
824
Y
2-1-f01-ep-08-1
Both identify the same port/line?
826
Y
N
error
806
N
error
806
AID also identifies an existing tributary?
812
2-1-#-#-08-1-19
or
2-1-f01-ep-#-#-19
or
2-1-f01-ep-08-1-19
Y
N
Retrieve PM data for identified port/line.
814
Retrieve PM data for identified tributary.
818
In all response messages, populate the AID with both the slot and port and the port protection group and line.
816
In all response messages, populate the AID with both the slot and port and the port protection group and line.
2-1-f01-ep-08-1
2-1-f01-ep-08-1-19
Completed
808

FIGURE 9


BEGIN
900
Establish a cross-connection
902
UPSR (or SNCP Ring) Add, Drop application?
904
N
other applications
916
Y
Valid tributaries selected for this application?
A=Path 1
B=Path 2
C= Add/Drop
906
N
error
918
Y
908
Decompose the compound cross-connection for this application into 3 atomic cross-connection commands for the NE:
1. Establish path-protected connection, inputs from Path 1 and from Path 2, output to Add/Drop (A or B to C)
2. Establish point-to-point connection, input from Add/Drop, output to Path 1 (C to A)
3. Establish point-to-point connection, input from Add/Drop, output to Path 2 (C to B)
910
Send commands to NE, including cross-connection application, a unique cross-connection number, and user-selected parameters.
912
NE establishes each atomic cross-connection and stores the cross-connection application code and the cross-connection number for each leg.
Completed
914

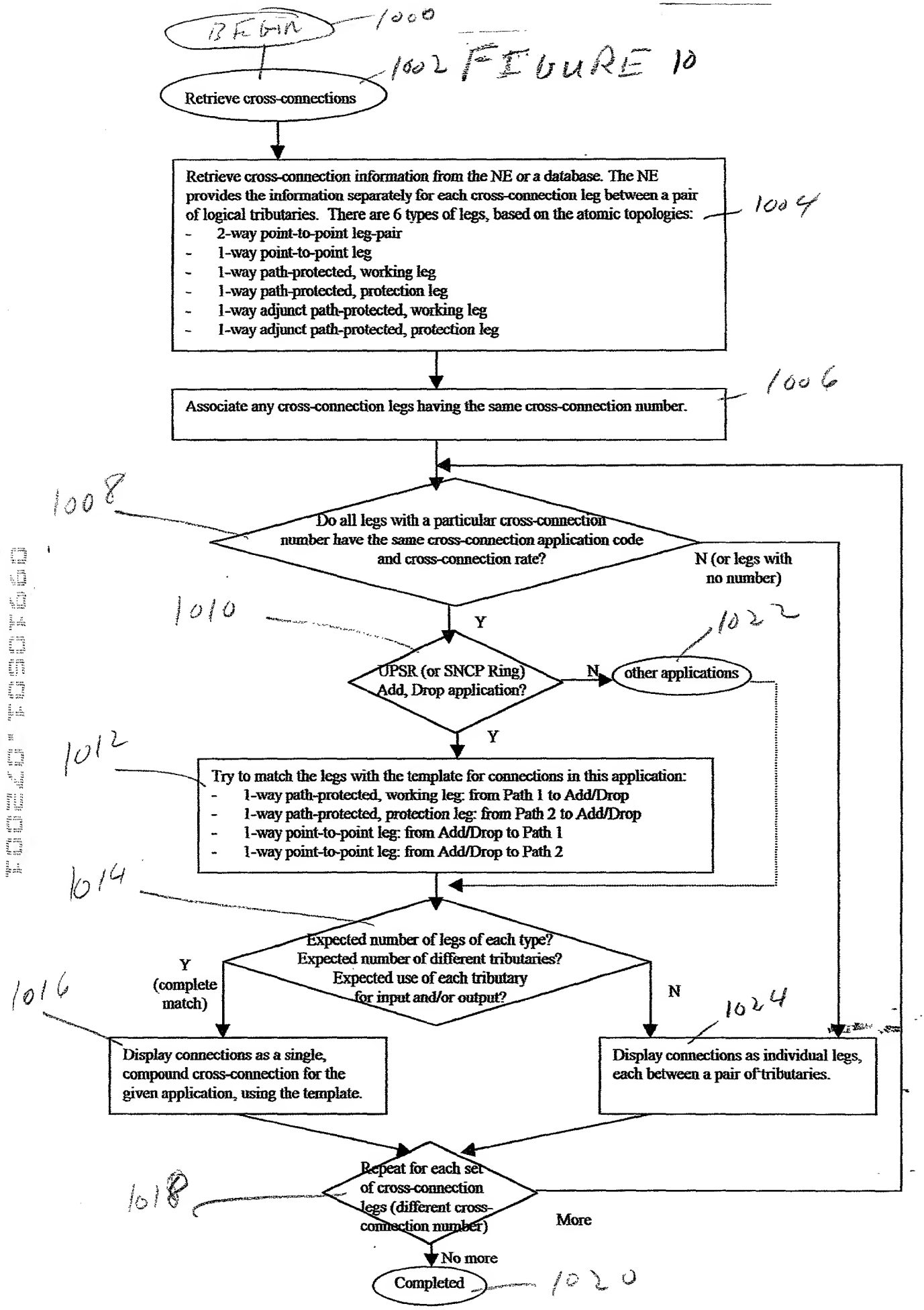

BEGIN
1000
1002
FIGURE 10
Retrieve cross-connections
Retrieve cross-connection information from the NE or a database. The NE provides the information separately for each cross-connection leg between a pair of logical tributaries. There are 6 types of legs, based on the atomic topologies:
- 2-way point-to-point leg-pair
- 1-way point-to-point leg
- 1-way path-protected, working leg
- 1-way path-protected, protection leg
- 1-way adjunct path-protected, working leg
- 1-way adjunct path-protected, protection leg
1004
Associate any cross-connection legs having the same cross-connection number.
1006
1008
Do all legs with a particular cross-connection number have the same cross-connection application code and cross-connection rate?
N (or legs with no number)
Y
1010
UPSR (or SNCP Ring) Add, Drop application?
N
other applications
1022
Y
1012
Try to match the legs with the template for connections in this application:
- 1-way path-protected, working leg: from Path 1 to Add/Drop
- 1-way path-protected, protection leg: from Path 2 to Add/Drop
- 1-way point-to-point leg: from Add/Drop to Path 1
- 1-way point-to-point leg: from Add/Drop to Path 2
1014
Expected number of legs of each type?
Expected number of different tributaries?
Expected use of each tributary for input and/or output?
Y (complete match)
N
1016
Display connections as a single, compound cross-connection for the given application, using the template.
1024
Display connections as individual legs, each between a pair of tributaries.
Repeat for each set of cross-connection legs (different cross-connection number)
1018
More
No more
Completed
1020

FIGURE 11

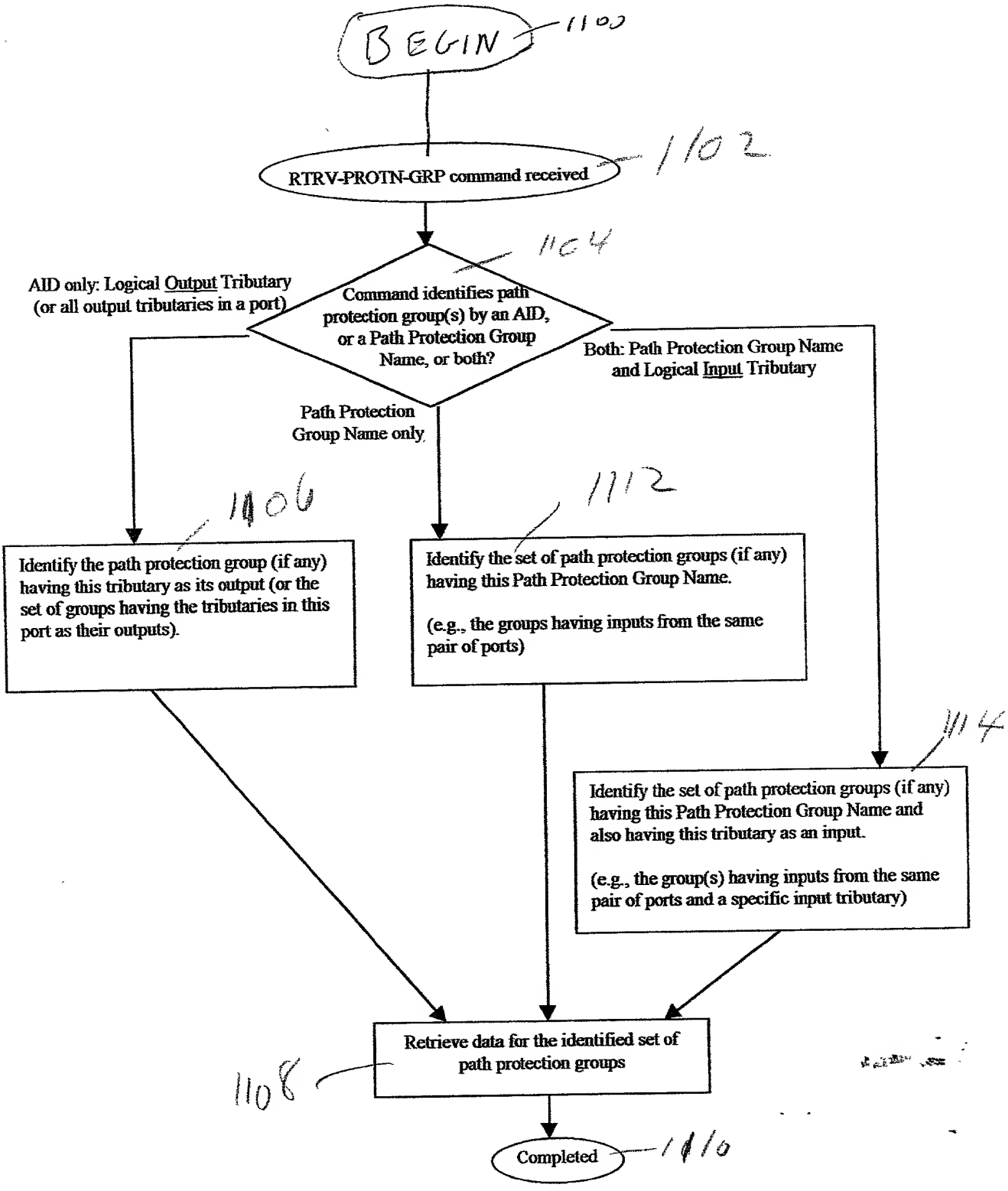

BEGIN
1100
RTRV-PROTN-GRP command received
1102
1104
Command identifies path protection group(s) by an AID, or a Path Protection Group Name, or both?
AID only: Logical Output Tributary (or all output tributaries in a port)
Path Protection Group Name only
Both: Path Protection Group Name and Logical Input Tributary
1106
Identify the path protection group (if any) having this tributary as its output (or the set of groups having the tributaries in this port as their outputs).
1112
Identify the set of path protection groups (if any) having this Path Protection Group Name.
(e.g., the groups having inputs from the same pair of ports)
1114
Identify the set of path protection groups (if any) having this Path Protection Group Name and also having this tributary as an input.
(e.g., the group(s) having inputs from the same pair of ports and a specific input tributary)
1108
Retrieve data for the identified set of path protection groups
Completed
1110

FIGURE 12

1. **XC Application = UPSR (or SNCP Ring) Add, Drop**
2. **Expected Leg-Pairs**
   - A', C', 2wayPS, W
   - B', C', 2wayPS,P

   OR
   - A', C', 2wayPS, P
   - B', C', 2wayPS,W
3. **Match Tributary AIDs (A', B', C') to the Tributary Labels in this application:**
   - A = "Path 1"
   - B = "Path 2"
   - C = "Add/Drop"
4. **Display fields:**
   - XC Rate
   - XC Application
   - AID "Path 1"
   - AID "Path 2"
   - AID "Add/Drop"
   - Indicate the Working input ("Path 1" or "Path 2")
   - Other XC parameters

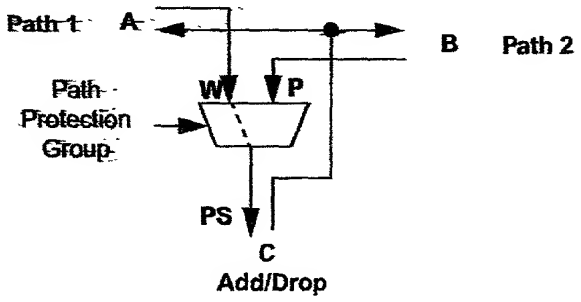


FIGURE 13

1. **Establish Cross-Connection: Select application from list (includes atomic xc's)**
   Example: UPSR (or SNCP Ring) Add, Drop
2. **Select XC Rate**
3. **Select Tributary AIDs, for the Tributary Labels in this application:**
   - **A = "Path 1"**
   - **B = "Path 2" (default is corresponding trib in opposite line)**
   - **C = "Add/Drop"**
4. **Select Working input (A or B, default is A)**
5. **Add other info as needed, including XC Number**
6. **Send 3 commands to NE:**
   a. **Establish path-protected xc, inputs from Path 1 and from Path 2, output to Add/Drop (A or B to C)**
   b. **Establish point-to-point xc, input from Add/Drop, output to Path 1 (C to A)**
   c. **Establish point-to-point xc, input from Add/Drop, output to Path 2 (C to B)**

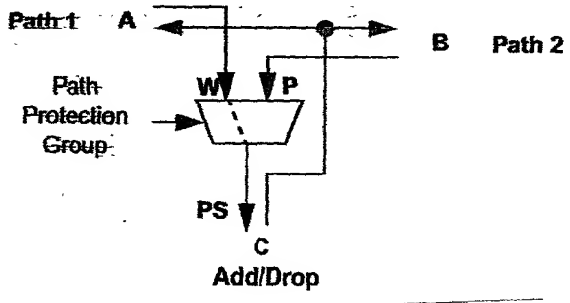


FIGURE 14

The examples in the next several figures show how Path Protection Group Names can be assigned to each set of path protection groups which the user may want to operate together, and separately from other sets. Where the figures show only a single group with a particular connectivity between ports and a unique label (e.g., "c"), this actually represents a set of path protection groups: one group for each of the STS-N/VC-N circuits using the tributaries of these ports.

The examples for a UPSR application are based on the application in figure 7.2. Traffic is interconnected between two UPSRs, and other traffic is dropped from each UPSR to other ports.

a. Typically, the same name would be assigned for all groups dropping traffic from a given UPSR:

- groups labelled a, b, c: UPSR#1
- groups labelled x, y, z: UPSR#2

b. Sometimes, the user may want to separately operate a subset of groups from a UPSR, depending on the destination:

- groups labelled a: UPSR#1toUPSR#2
- groups labelled b: UPSR#1toOC3#1
- groups labelled c: UPSR#1toOC3#2
- groups labelled x: UPSR#2toUPSR#1
- groups labelled y: UPSR#2toOC3#1
- groups labelled z: UPSR#2toOC3#2

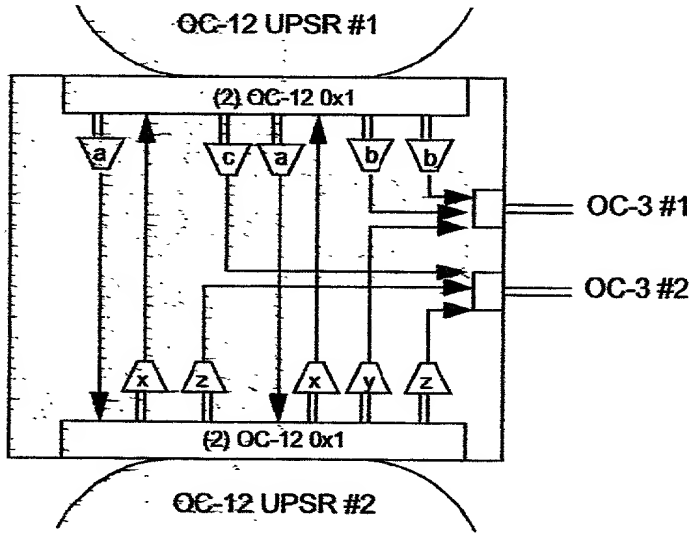


FIGURE 15

These examples for a Logical Rings application are based on the application in figure 3.3, on the right-hand side, but with two OC-12 rings instead of one. In these examples, STS-N path-protected traffic (in what would normally be two OC-12 UPSRs, B1 and B2) is transported through an OC-48 BLSR, and some of this traffic is dropped by the same network element which provides a BLSR node. In other words, traffic is dropped from Logical Rings consisting of tributaries on ports A and B1, or tributaries on ports A and B2.

a. Typically, the same name would be assigned for all groups dropping traffic from a given pair of ports:

- groups labelled w, x: LogicalRing#AB1
- groups labelled y, z: LogicalRing#AB2

b. Sometimes, the user may want to separately operate a subset of groups from a pair of ports, depending on the destination:

- groups labelled w: LogicalRing#AB1toOC3#1
- groups labelled x: LogicalRing#AB1toOC3#2
- groups labelled y: LogicalRing#AB2toOC3#1
- groups labelled z: LogicalRing#AB2toOC3#2

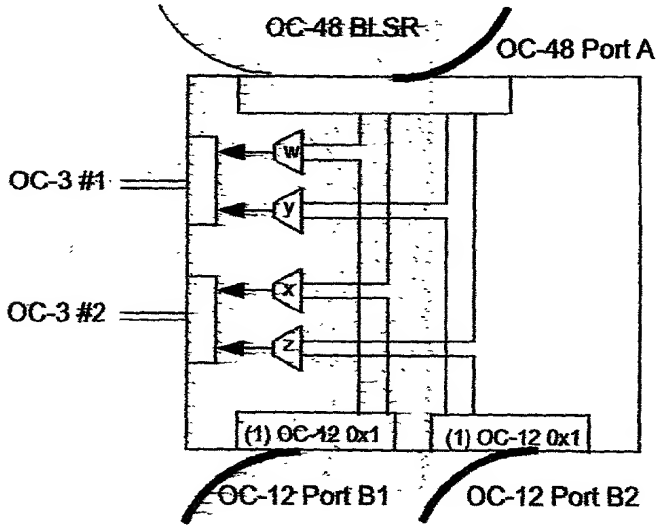


FIGURE 16

This example is for Ring Interworking with the Drop-and-Continue method, for BLSR Primary Nodes in the Same NE. It is based on the application in figure 3.1-b, but with an OC-192 BLSR on the top and two OC-48 BLSRs instead of one on the bottom. In this example, some of the traffic is transported through each given pair of BLSRs and protected by ring interworking between that pair of BLSRs. This same NE serves as the primary node in both BLSRs for each of these circuits.

Typically, the same name would be assigned for all groups selecting traffic from a given pair of ports. For ring interworking with drop-and-continue in a BLSR (and primary nodes in the same NE), these groups are selecting either the "continue" traffic, drawn from the port receiving from the secondary node in the same ring, or the "inter-ring" traffic, drawn from the port receiving from the terminating node in one of the other rings. The names used in this example identify these two ports, in this order. Also in this example, the secondary nodes for these particular circuits in BLSRs 1, 2, and 3 are in the direction of ports A, C, and E, respectively, and the terminating nodes are in the direction of ports B, D, and F, respectively.

- groups labelled u: BLSR#1A-BLSR#2D
- groups labelled v: BLSR#1A-BLSR#3F
- groups labelled w: BLSR#2C-BLSR#1B
- groups labelled x: BLSR#2C-BLSR#3F
- groups labelled ŷ: BLSR#3E-BLSR#1B
- groups labelled z: BLSR#3E-BLSR#2D